

positioning unit, news feed, or a pager. In these embodiments, the data device communicates information to the display which then displays the information for the wearer.

Wearable displays can be incorporated into other wearable items such as shoes, socks, pants, underwear, wallets, key chains, shoe laces, suspenders, ties, bow ties, buttons, buckles, shirts, jackets, skirts, dresses, ear muffs, hats, glasses, contact lenses, watches, cuff links, wallet chains, belts, backpacks, briefcases, pocket books, gloves, raincoats, watchbands, bracelets, overcoats, windbreakers, vests, ponchos, waistcoats, or any other article of clothing or fashion accessory.

In still another aspect, the invention features a communications system. The communications system enables a whole new messaging and communication medium that permits its users to display messages in real time in practically any location.

Referring to FIG. 10, the system 1000 comprises a plurality of display receivers 1002. The display receivers 1002 include an electronic display 1004 and a data receiver 1006. In certain embodiments, the display receivers are tile displays or radio papers, as described above. The electronic display 1004 can operate by principles known to the art of LCDs, plasma displays, CRTs, electrophoretic displays or encapsulated electrophoretic displays. The encapsulated electrophoretic display may be coated onto many different surfaces practically any surface using appropriate binders such as PVCs, urethanes and silicon binders, allowing them to be: made in large sizes (such as poster and billboard sizes) using coating techniques; lightweight enough to install without an overhead crane; flexible enough to bend with wind; and capable of holding an image without further power draw, thereby operating economically from solar cells or batteries.

The data receiver 1006 may be, for example, a pager, cellular phone, satellite phone, radio-frequency receiver, infrared receiver, cable modem, or any other suitable receiver that is able to receive information from another source. The data receiver 1006 can transmit as well as receive information; for example the data receiver 1006 may transmit verification information to confirm that a new data stream was received. The data receiver 1006 may transmit data as may be useful for the overall operation of the system 1000, for example weather data as part of a national weather system. The data receiver 1006 may use varying or multiple transmission methods for both receiving and transmitting data.

The function of the data receiver 1006 is primarily to receive data and to display text or images in response. The data can include a message, a stream of messages, codes describing how the device should display or transition between the messages, or any other suitable information that will cause the display 1004 to operate as desired by the user. The data can also include a header, error-checking, checksum, routing or other information that facilitates the function of the system 1000.

In one embodiment, the data receiver 1006 includes a control system 1008. The control system 1008 facilitates the operation of the communications system 1000. In one embodiment, the control system 1008 functions as a user interface that permits the user to design, author, test, collaborate, approve and/or transmit images and commands that are sent to the display receivers. In another embodiment, the control system 1008 functions as a billing and authorization system that monitors the user's activity, verifies

payment has been received, verifies that the account is in good standing, verifies that the user has proper authorization, creates usage reports, generates invoices, and/or updates data receivers due to unsatisfactory billing status.

In another embodiment, the control system 1008 functions as a data receiver management system that tracks data receivers, generates reports of data receiver history and status, permits sorting and screening of data receivers based on suitable characteristics, and/or permits the user to assign messages to the entire network of data receivers or subsets thereof. In still another embodiment, the control system 1008 functions as a data transmission system that pre-processes data into a format suitable for the data receivers or subsets thereof, transmits the data by the method necessary or most suitable for each data receiver, schedules the transmission of the data according to desired criteria, verifies that the data was properly sent, receives and processes any information uploaded from the data receivers 1006, resends messages that may not have been received, generates reports of such activities, and/or generates messages to field personnel indicating potential service requirements.

In all of the above embodiments, the control system may utilize the Internet or the World Wide Web as a user interface, as a data transmission mechanism, as an error-checking protocol, as a messaging service, as a programming environment or in any suitable fashion. The control system 1008 may also utilize data encryption mechanisms for enhanced security in the user interaction, in the system operation, in the data receiver transmission or in the data receiver reception. The control system 1008 may also utilize a suitable digital payment scheme to enable funds to be transferred as a part of the overall system of usage and operation.

While the invention has been particularly shown and described with reference to specific preferred embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. An indicator comprising:

a substrate;

a transducer disposed on the substrate the transducer producing signals in response to a stimulus; and

an encapsulated electrophoretic display printed on the substrate in electrical communication with the transducer, the display displaying a visible optical state indicative of the presence of the stimulus in response to the signals from the transducer.

2. The indicator of claim 1, wherein the transducer comprises an electrical junction having a current-voltage characteristic that changes as a function of time.

3. The indicator of claim 1, wherein the transducer comprises a mechanical system responsive to a change in pressure.

4. The indicator of claim 1, wherein the transducer comprises a thermally responsive structure.

5. The indicator of claim 1, wherein the transducer comprises a photosensitive structure.

6. The indicator of claim 1, wherein the transducer comprises a structure responsive to moisture.

7. The indicator of claim 1, wherein the transducer comprises an acoustically responsive structure.

8. The indicator of claim 1, wherein the transducer comprises a structure responsive to the orientation of the substrate.